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Case Report

Brachial Plexopathy Following an Electrocution Accident: A Case Report and Review of Literature

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Abstract

This report presents a case of a 41-year-old male who sustained an accidental electrocution while handling a bare electrical cable with his right index finger. The electrical current passed from the upper limb to the neck, resulting in severe neuralgia and paresis of the right brachial plexus. Electroneuromyography (ENMG) performed six weeks after the incident revealed involvement of the lower primary trunk of the right brachial plexus, characterized by absent sensory potentials in the ulnar and internal brachiocutaneous nerves and reduced motor potentials in the ulnar and median nerves. The patient exhibited decreased osteotendinous reflexes and motor weakness in the affected limb, accompanied by paroxysmal pain radiating from the shoulder to the wrist. Treatment comprised gabapentin for neuropathic pain, ketoprofen as an anti-inflammatory, and physiotherapy rehabilitation. After one month, the patient showed complete motor recovery and significant pain relief. Unfortunately, MRI of the brachial plexus was not performed due to financial constraints. This case underlines the rarity of unilateral brachial plexopathy following electrocution, a condition infrequently reported in medical literature, especially in the African context. The pathophysiological mechanisms include thermal injury, electroporation, and ischemic nerve damage. Early electrophysiological assessment and tailored rehabilitation are crucial to optimize neurological recovery and prevent chronic sequelae. The report highlights the need for increased awareness and specialized management of peripheral nerve injuries secondary to electrical accidents to improve functional outcomes.

Keywords

Brachial Plexopathy, Electrocution, Peripheral Neuropathy, Physiotherapy, Functional Recovery

1. Introduction

Peripheral nervous system damage following electrocution is poorly understood [1]. Electric current can damage any tissue in the body encountered during its passage, either temporarily or permanently. Also called electrotrauma, electrocution refers to all the physiological and pathophysiological manifestations due to the passage of electric current through the human body [2-4]. Epidemiological data relating to electrocution accidents (ECA) probably underestimate their

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real incidence because many minor events occurring at work or in the home do not give rise to a medical consultation or an accident report [5]. We report the case of a patient from 41 years old who developed a picture of unilateral brachial plexopathy following a electrification.

2. Patient and Observation

A 41-year-old patient with no particular medical history came to see us for paresthesias in his right wrist. He had been electrocuted at work when he tried to start an electric motor used to recycle wastewater. A few minutes after the accident, he felt severe pain in his right wrist. The patient was immediately taken to the nearest medical facility where he received pain relief, which led to a temporary relief of about an hour. Forty-five minutes later, the patient developed difficulty moving his right arm properly. Since then, he has experienced weakness in his right upper limb and paroxysmal pain in the form of an electric shock running from his shoulder to his wrist. The neurological examination revealed a decrease in osteotendinous reflexes in the right upper limb, paresis of the right upper limb, and poorly systematized neuralgia extending from the shoulder to the right wrist, triggered by the abduction movement of the arm. Electroneuromyography performed 6 weeks later (ENMG) revealed:

In nerve conduction: absence of sensory potentials on the nerve trunks of the right ulnar and internal brachiocutaneous muscles and reduction of motor potentials on the right ulnar and median muscles (Tables 1 and 3).

Upon detection:

At rest: the presence of fibrillation potentials was noted on the right first interosseous and fasciculation potentials on the right fifth finger abductor.

During exercise: a simple, accelerated, poor, and polyphasic tracing was observed on the right first interosseous muscle. An intermediate tracing was also found on the flexor carpi ulnaris and the abductor of the fifth finger. Motor and sensory conduction of the nerves in the left upper limb was normal (Tables 2 and 4). All these electrophysiological abnormalities explain the involvement of the lower primary trunk of the right brachial plexus. The patient received treatment with gabapentin and ketoprofen. And The patient underwent physiotherapy rehabilitation with favorable progress and complete motor functional recovery. Reassessed one month later, the pain had significantly decreased. The MRI of the brachial plexus was not performed due to the patient's lack of financial means.

Table 1. *Motor conduction in the right upper limb.*

Nerve		Distal latency (ms)	Duration (ms)	Amplitude (mV)	Surface area (µVs)	Distance (cm)	Speed (m/s)	LatencyF wave (ms)
Median	Wrist	3.7	6.2	4.3	14.9			
	Elbow	9.2	4.2	2.9	7.2	29.0	52.7	30.2
	Axillary	10	4.6	3.7	10.9	8.0	100.0	
	Erb	16.6	4.8	3.8	8.9	35.0	76.1	
Ulnar	Wrist	2.8	5.5	2.3	6.5		49.0	
	Under-elbow	7.0	7.0	2.3	9.6	30.0	71.4	26.7
	Over-elbow	9.4	6.3	2.5	8.3	10.0	41.7	
	Axillary	12.8	8.9	2.1	11.2	28.0	96.6	
Radial	Forearm	2.2	6.6	8.7	29.5		44.2	
	Elbow	4.5	7.1	7.9	33.8	15	65.2	

Table 2. *Motor conduction in the left upper limb.*

Nerve		Latency distal (ms)	Duration (ms)	Amplitude (mV)	Surface area (µVs)	Distance (cm)	Speed (m/s)	Latency F wave (ms)
Median	Wrist	3.2	6.5	8.4	32.9			23.4
	Elbow	7.7	5.6	7.8	22.0	29.0	64.4	

Nerve		Latency distal (ms)	Duration (ms)	Amplitude (mV)	Surface area (µVs)	Distance (cm)	Speed (m/s)	Latency F wave (ms)
Ulnar	Wrist	3.4	5.5	9.2	19.5			26.7
	Under-elbow	6.6	4.2	8.8	17.5	31.0	96.9	

Table 3. Sensory conduction in the right upper limb.

Nerves		Latencydi-stal (ms)	Duration (ms)	Amplitude (mV)	Surface (µVs)	Distance (cm)	Speed (m/s)
Median	Palm orthodromic	2.0	1.8	23.3		10.0	50.0
Ulnar	Palm	----------	----------	----------	----------	----------	----------
Radial	Snuffbox	1.5	1.5	26.3	1.5	10.0	66.7
Musculocutaneous	Forearm	4.0	1.5	93.5	1040.4	10.0	25
Brachiocutaneous internal	Forearm	----------	----------	----------	----------	----------	----------

Table 4. Sensory conduction in the left upper limb.

Nerves	Sites	Latencydi-stal (ms)	Duration (ms)	Amplitude (mV)	Surface (µVs)	Distance (cm)	Speed (m/s)
Median	Palm	1.7	2.0	18.7		10.0	58.8
Ulnar	Palm	1.9	2.1	15.7		10.0	52.6
Radial	Snuffbox	1.5	1.5	26.3	1.5	10.0	66.7
Musculocutaneous	Forearm	4.0	1.5	93.5	1040.4	10.0	25
Brachiocutaneous internal	Forearm	3.5	2	10.2		10.0	48

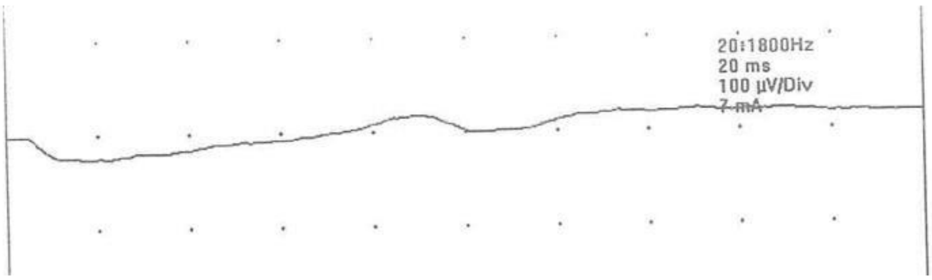

Figure 1. Sensory conduction of the right ulnar nerve: Absence of sensory potentials on the right ulnar nerve trunk.

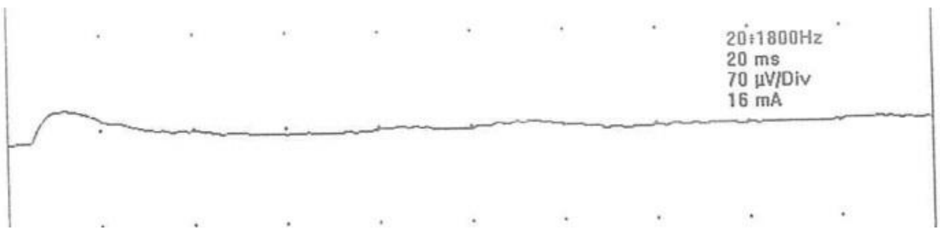

Figure 2. Sensory conduction of the right internal brachiocutaneous nerve:Absence of sensory potentials on the right internal brachiocutaneous nerve trunk.

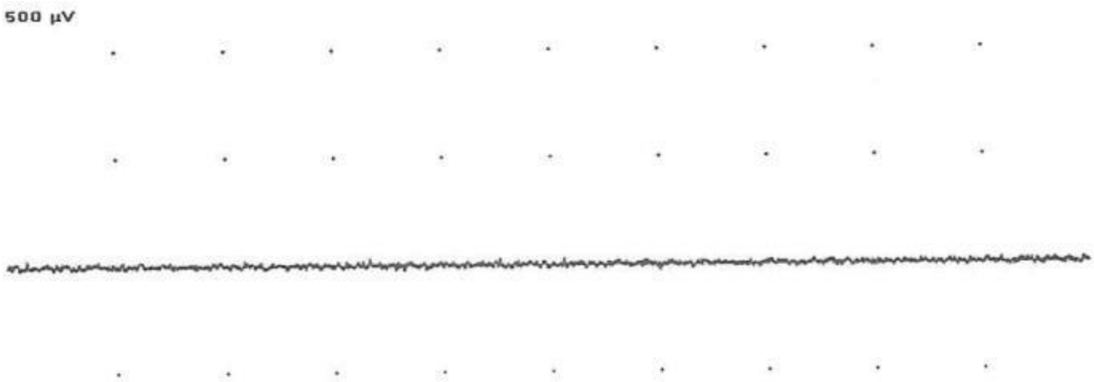

Figure 3. Resting EMG of the right first interosseous.:Fibrillation potentials on the right first interosseous.

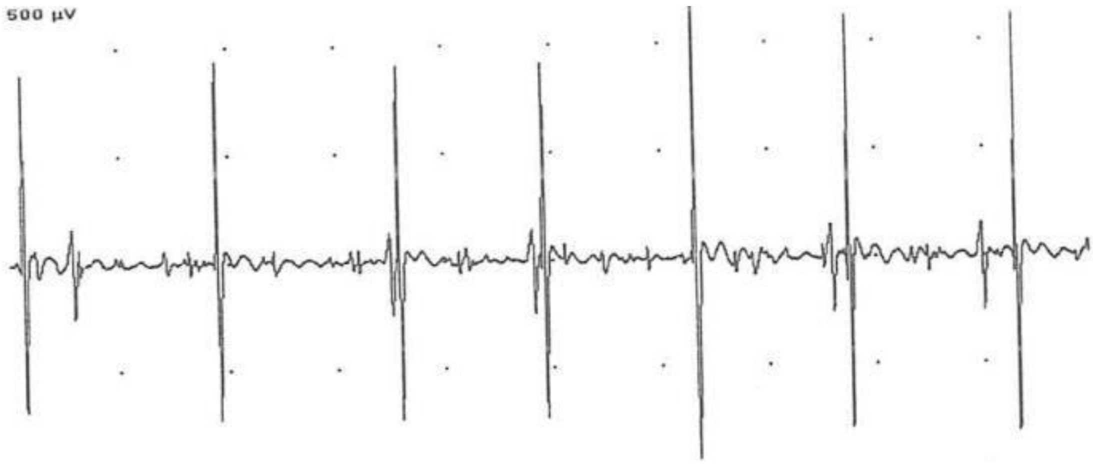

Figure 4. Resting EMG of the right fifth finger abductor.; Fasciculations potentials on the abductor of the right fifth finger.

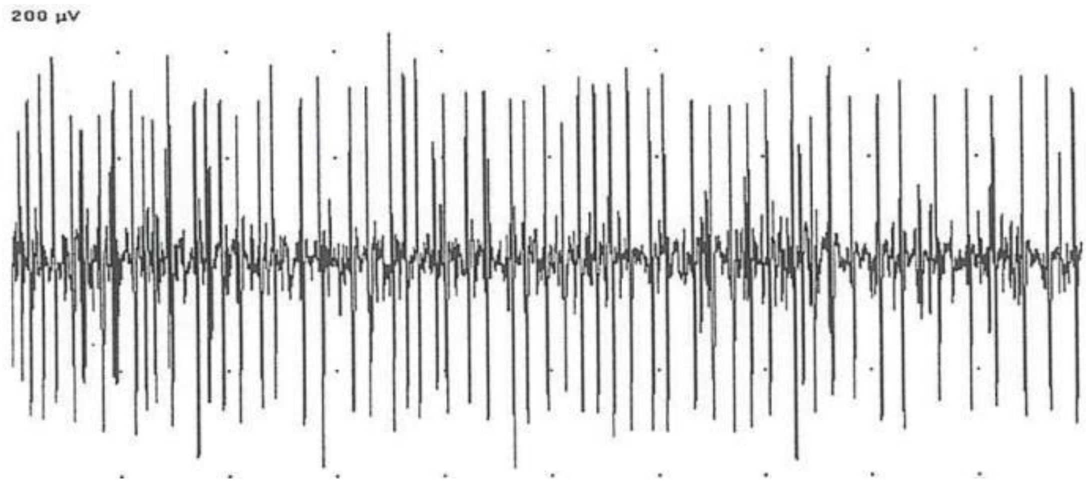

Figure 5. EMG:detection of the first right interosseous bone:Simple, accelerated, poor, and polyphasic tracing on the right first interosseous.

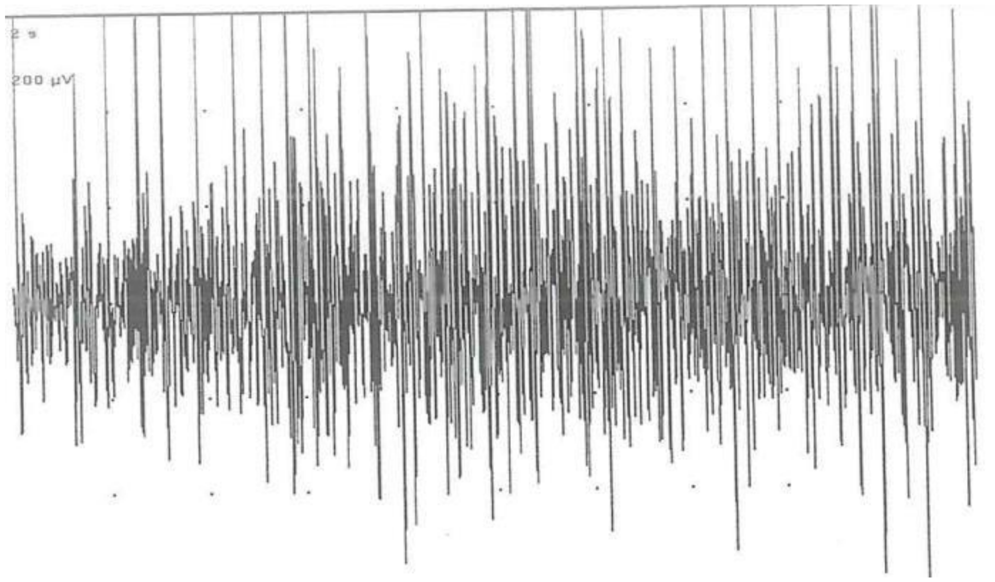

Figure 6. *EMG: detection on the ulnar flexor of the carpus.:Intermediate tracing on the flexor carpi ulnaris.*

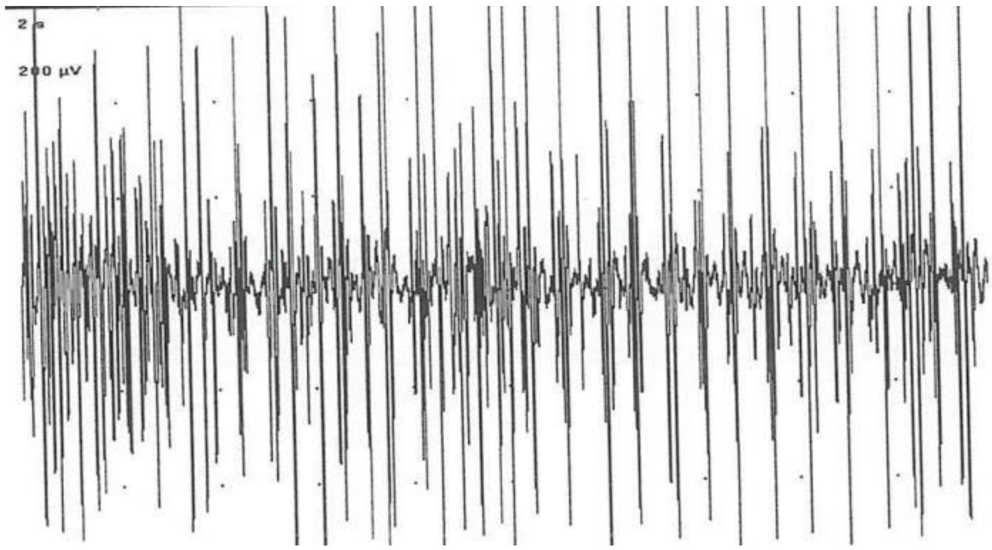

Figure 7. *Detection on the Abductor of the Fifth Finger.*

3. Discussion

Peripheral neuropathies affect 1/5 of electrified patients, and regress two out of three times. They are responsible for causalgia, paresis, paraesthesia and hypoesthesia in the affected area, and rarely paralysis which is however more unpleasant [6]. Lesions of the peripheral nervous system (PNS) are associated to varying degrees: sometimes isolated neuralgia, motor deficit, amyotrophy, superficial hypoesthesia, abolition of osteotendinous reflexes (OTR) [7]. PNS damage after electrification has only rarely been described. However, they could be underestimated, because they are in the background of the clinical picture: of variable severity, they are not the subject, except in exceptional cases, of investigations in a specialized neurological environment. Five mechanisms have been suggested to explain the pathophysiology of these neuropathies [8-10]: (1) nerve ischemia by intense vasoconstriction due to massive autonomic stimulation. · Direct action of electricity; (2) nerve compression by bone fractures or burn scars; (3) conduction block in peripheral nerves by electric current; (4) and (5) thermal effect Neuroinflammation: Electroporation can trigger an immune response. Activated glial cells (microglia) and endothelial cells release inflammatory mediators that can damage neurons and disrupt the blood-brain barrier.. Peripheral nerve damage following electrification frequently involves the median, ulnar, radial and peroneal nerves, but all nerves can be damaged [4]. In our observation, the main nerves arising from the right brachial plexus were affected. To our knowledge, no cases of plexus damage due to electrification have been described in our setting. Plexopathies caused by an electrification accident have been rarely reported in the literature and unilateral plexopathies much more rarely [1, 11-14]. The only detailed observation is that of Suematsu et al. described in 1989. It concerned a 14-year-old boy who was electrified by an alternating current of 100 volts, with the 5th finger of the right hand as the entry point. A picture of ipsilateral brachial plexopathy set in within a few hours, with severe motor deficit predominantly distal, global anesthesia of the limb and areflexia. The patient recovered completely within 3 months [13]. Our patient presented with unilateral plexopathy after an electrification starting from his second finger of the right hand. Neurological lesions related to the path of the current along the nerve axes are the consequence of the thermal effect and the phenomenon of electroporation (disturbance of the membrane excitability threshold due to the electric field). Experimentally, the thermal effect can be responsible for nerve lesions by ballooning of the myelin sheath, fragmentation and coiling of the axon and necrotic thrombotic or hemorrhagic vascular lesions [15]. In fact, the low resistance of the nerve axes makes them relatively resistant to the thermal effect [1, 16]. Regarding the evolution, the morbidity caused by AEs is considerable and the sequelae, in particular neurological and psychological, can be very disabling [17]. In relation to our observation, after one month of treatment, our patient has progressed well clinically and electrophysiologically.

4. Conclusion

The effects of electrical current on the peripheral nervous system are likely underestimated. Pathophysiological hypotheses remain uncertain and are based on experiments conducted using electrical currents. In cases of post-electric plexopathy, neuropathic pain, motor weakness, and sensory disturbances can persist for a long time. Without appropriate treatment and rehabilitation, neurological sequelae worsen, leading to functional disability and impaired quality of life.

Abbreviations

ENMG	Electro-neuromyogram
MRC	Medical Council Research
AE	Electrocution Accident
ROT	Osteotendinous Reflexes
PNS	Peripheral Nervous System

Author Contributions

Marcellin Bugeme Baguma: Conceptualization, Methodology

Halladain Mpung Mansoj: Funding acquisition, Writing – original draft

Franck Omangelo Shongo: Investigation, Validation

Sarah Numbi Kilumba: Resources

Emmanuel Kiyana Muyumba: Funding acquisition, Supervision

Conflicts of Interest

The authors declare that they have no conflict of interest.

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